**IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA**

STATE OF OKLAHOMA,	)	
	)	
Plaintiff,	)	
	)	
v.	)	**Case No. 4:05-cv-00329-GKF (PJC)**
	)	
TYSON FOODS, INC., et al.,	)	
	)	
Defendants.	)	

DECLARATION OF DR. CHRISTOPHER M. TEAF

The undersigned, Christopher M. Teaf, Ph.D., hereby declares as follows:

1. My educational background includes a Bachelor's degree in Biology (*with Honors*) from Pennsylvania State University and a Master's degree in Biological Science from Florida State University. I earned my Ph.D. in Toxicology from the University of Arkansas for Medical Sciences (Little Rock, Arkansas) and conducted my research at the National Center for Toxicological Research (Jefferson, Arkansas). I presently hold positions as Associate Director in the Center for Biomedical & Toxicological Research and Waste Management at Florida State University (since 1983), as well as Director of Toxicology for the research firm of Hazardous Substance & Waste Management Research, Inc. (since 1985; President since 1989). I have held adjunct teaching appointments at the Florida State University/State University System Program in Medical Sciences, at the Florida A & M University College of Pharmacy and Pharmaceutical Sciences, and at the Interdisciplinary Toxicology Program within the University of Arkansas for Medical Sciences.

EXHIBIT
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2. I hold Board certification with status as a Fellow of the Academy of Toxicological Sciences. A complete copy of my Curriculum Vitae is included as Attachment A to this Declaration.

3. My research and scientific advisory activities principally are in the area of risk assessment for human exposure to occupational and/or environmental chemical and biological hazards. My principal activities for well over 25 years have included the performance of risk assessments concerning human health and the evaluation of adverse effects of chemical and biological exposures under the requirements of the Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, Superfund), Superfund Amendments and Reauthorization Act (SARA), the Toxic Substances Control Act (TSCA), the Occupational Safety and Health Act (OSHA), and other related federal or state legislation. My activities have involved the evaluation of potential human health impacts of many organic substances (e.g., pesticides, chlorinated and non-chlorinated compounds, petroleum products), inorganic agents (e.g., acids/caustics, metals, particulates, fibers) and microbiota (e.g., bacteria, molds, fungi) in air, water, soils and sediments.

4. I have served as a peer reviewer for many publications submitted to numerous scientific journals including *Human & Ecological Risk Assessment; Risk Analysis; Environmental Forensics; Nonlinearity in Biology, Toxicology and Medicine; Environmental Toxicology & Chemistry; Integrated Environmental Assessment & Management; Bulletin of Marine Science; Ohio Journal of Science; Chemosphere;* and *Environmental Biology of Fishes*, and I presently serve on the Editorial Boards for several of these scientific journals. I currently am Senior Editor for Human Risk Assessment for the international journal *Human & Ecological Risk Assessment*, a position I have held for about five years. I have published many scientific papers, articles and book chapters concerning toxicological effects, exposure assessment, and risk evaluations related to environmental and occupational exposures and potential effects.

5. For over 25 years, I have directed and conducted research projects and human health education activities for many agencies such as the World Health Organization (WHO), the North Atlantic Treaty Organization (NATO), the U.S. Environmental Protection Agency (U.S. EPA), the U.S. Department of Energy (U.S.

DOE), the U.S. Department of Agriculture (U.S. DOA), the federal Agency for Toxic Substances and Disease Registry (ATSDR), the Florida Department of Environmental Protection (FDEP), the Florida Department of Health (FDOH), the Florida Department of Community Affairs, and many municipal or other local governmental entities. These activities have been conducted in the United States, as well as Eastern Europe (e.g., Bulgaria, Czech Republic, Hungary, Poland), in Central Asia (e.g., Kazakhstan), and in Russia.

6. For many years, I have provided advisory services on toxicology, risk assessment, and environmental health issues to legal agencies and organizations, including the U.S. Department of Justice, Florida State Attorney's Office, and Attorneys General for Florida, Washington, and Oklahoma. I have been qualified to provide expert testimony to federal and state courts, to arbitration or administrative proceedings, and to regulatory or legislative groups in the subject areas of toxicology, environmental chemistry, occupational exposure, health effects of chemicals, and health risk assessment since 1986.

7. I have reviewed the document entitled "Defendants' Motion to Exclude the Testimony of Dr. Christopher Teaf and Integrated Brief in Support" that is before the Court. In this Declaration, supported by the accompanying Attachments, I present the following principal points:

- By virtue of my education, training and experience, I am qualified to assess and interpret actual and potential risks associated with levels of bacteria, disinfectant byproducts (DBPs) and cyanobacteria in the waters of the Illinois River Watershed (IRW) including those that exceed known regulatory standards or guidelines.
- My opinion that the spreading of poultry waste on fields in the IRW represents a threat to human health from several perspectives, including bacteria, formation of DBPs, and cyanobacterial growth, was formed based on a weight of evidence approach which is well-supported by the scientific literature. The lines of evidence are supported by data from published literature, land use information, quantities of poultry waste applied to fields, the pathogens and other microorganisms that are known to be shed in poultry feces, environmental sampling and analysis, laboratory studies, and knowledge of the hydrology and geology of the IRW. This opinion was developed according to approaches, technical information, scientific data and sworn testimony which have been gathered and used according to accepted

principles and practices employed in the field of human health risk assessment.

8. A detailed and focused discussion of these principal points is presented in the following sections of my Declaration. The references and publications cited in those sections are presented in Attachment B to this Declaration.

I. I am fully qualified to give an expert opinion regarding the risks to human health that are or may be associated with exposure to bacteria, DBPs and cyanobacteria.

9. My educational history includes a Bachelor's degree in Biology (with Honors) from Pennsylvania State University, a Master's degree in Biological Science from Florida State University, and a Ph.D. in Toxicology from the University of Arkansas for Medical Sciences. This educational background has included relevant and appropriate coursework and/or research in the areas of zoology, aquatic biology, microbiology, environmental chemistry, statistics, toxicology, pathology, and human health risk assessment.

10. I presently hold positions as Associate Director at the Center for Biomedical & Toxicological Research and Waste Management at Florida State University (since 1983), and Director of Toxicology for the research firm of Hazardous Substance & Waste Management Research, Inc. (since 1985; President since 1989).

11. Over 32 years, my research, classroom teaching, technical project direction/involvement, and sworn testimony, provide ample evidence of extensive experience concerning environmental exposure assessment, potential human health effects evaluation, health/safety issues associated with microbiological impacts (*e.g., spray irrigation of municipal reuse water, sewage overflows in surface water bodies, aerosols from cooling towers and sewage treatment plant operations, air/water sampling in buildings, and health considerations related to microbial presence and bacterial generation of chemical agents in air*), cyanobacteria and cyanobacterial toxins in surface waters, and the presence or significance of DBPs in drinking water supplies. I have acted as a scientific advisor on these subjects to numerous local, state, national and international agencies and organizations. In addition, I have published a number of articles and have made many technical presentations regarding these issues and others which are important to an understanding of aggregate considerations of exposure and human health risk, including presenting to scientific meetings on issues related to this case (e.g., Teaf , 2006; Teaf et al., 2008b).

12. While it technically may be true that my training and experience are not exclusively focused on any one of the cited subject areas, the strict application of such a criterion to evaluation of credentials in this instance is not appropriate. That situation is common and accepted in the human health risk assessment field, where the interdisciplinary evaluation of human health risks from multiple sources of biological and/or chemical exposure is necessary and standard (e.g., Artiola et al., 2004; Reichard et al., 2000; Haas et al., 1999).

13. A complete copy of my Curriculum Vitae is included as Attachment A to this Declaration.

II. My opinions regarding human health risks associated with bacteria from land applied poultry waste are well-founded, are wholly consistent with the assessment of such data by state and federal environment and health agencies, and are supported by the results of reliable tests.

14. My expert report (Teaf, 2008a) details the multiple lines of evidence that I have relied on to form my expert opinions in this case. Those lines of evidence are composed of information drawn from the peer reviewed scientific literature, from many governmental assessments and guidance documents, from reviews of raw data collected in this case, and from a review of the affidavits, declarations and expert reports of both Plaintiff and Defense experts. Contamination of surface water and groundwater supplies by bacteria has long been recognized as a human health concern in the United States and around the world. The number and diversity of these potential contaminants has resulted in the development of practical assessment and protection strategies which employ "indicator organisms" as surrogates for quantification of specific pathogen species in water bodies (Barrell et al., 2000; U.S. EPA, 2003; National Research Council, 2004; Tortorello, 2003; U.S. EPA, 2004; Harwood et al., 2005; Teplitski and Butler, 2009). These indicator organisms, such as *Escherichia coli* (*E. coli*), enterococci, and fecal coliform bacteria, may or may not cause illness directly, but they have demonstrated characteristics which make them reliable indicators of other harmful pathogens in water and represent a measure of fecal contamination that are easier to measure in the environment than are pathogens (Wade et al., 2006). Nonetheless, literature does suggest that "Enterococci are also capable of causing a variety of community-acquired infections" (Moellering, 1992). As with any important scientific endeavor, improvements are constantly sought in refining the applicable and recommended methods for such evaluations. However, despite ongoing dialogue and technical meetings on this subject for many years (e.g., U.S. EPA, 2007), individual state environmental agencies and the U.S. EPA continue to employ the indicator organism paradigm as a principal and dominant strategy for how aquatic microbial health risks are characterized and evaluated.

15. Using the approaches articulated in the 2004 U.S. EPA *Implementation Guidance for Ambient Water Quality Criteria for Bacteria*, health risks for a Primary Body Contact Recreation (PBCR) waterbody such as the IRW, as designated by the State of Oklahoma under the Clean Water Act 303d process, can be estimated by comparison of measured values in a water body with the applicable numerical regulatory criteria used. Therefore, it is not an obligation in Oklahoma or other states to find the actual pathogens in the environmental media if the "indicator organism" approach is used. That U.S. EPA (2004) document provides detailed information regarding the basis for the environmental and health agency recommendations, including discussions on the epidemiology of microbiological disease related to water uses such as swimming, kayaking, water skiing, and other activities where direct contact and immersion in the water are likely.

16. The standard toxicological approach to chemical risk assessment must be modified in order to apply to the bacteria or the cyanobacteria found in the IRW. Haas (2002) described many of the inherent difficulties when attempting to establish a dose-response for microbial agents. As an alternative to the risk assessment technique of chemical dose response in this case, risks were determined by comparison of detected measurements with regulatory values and guidelines, the derivation of and assumptions underlying which are well-known and historically defined. Above the threshold levels listed in the 2004 U.S. EPA *Implementation Guidance*, the agency noted that illness rates are expected to rise sharply, and the health-based recommendations are that levels should remain below that part of the statistical curve (0.8 to 1% risk of illness, or 8 to 10 cases in 1,000). The State of Oklahoma, along with essentially all other states, has adopted these or very similar "indicator organism" criteria as a fundamental element of their water quality criteria for the protection of human health. There is nothing unusual or unique about the State of Oklahoma's approach and, in fact, it would be quite unusual not to use that approach. This approach is standard, is correct, and Defendant experts have not identified any scientific literature or regulatory guidance which supports an alternative method that has practical application and which is presently in common use.

17. My assumptions regarding the likelihood of pathogenic bacteria being present as a result of the identification of indicator bacteria are based on specific and supporting factsas subsequently presented**.** As stated in Harwood (2008) and Harwood (2009), many bacteria (e.g., *Campylobacter*) may enter a "viable but nonculturable" (VBNC) state in response to stress from environmental factors including starvation, dessication, and exposure to UV light (e.g., Jones, 2001; Fricker, 2003). "In this state pathogens are metabolically active ("living"), but they cannot be cultured on media routinely used for their isolation" (Harwood, 2008). The methodology used, as well as the well-known phenomenon of VBNC, may explain why some of the pathogenic bacteria were not detected in environmental samples from the IRW. In support of that conclusion, a reference used by one of the defendants experts, Dr. DuPont (Talibart et al., 2000), clearly notes that "These results suggest that viable but non-cultivable forms of *Campylobacter* could be a potential risk of colonization of human or animals … ." Another reference cited by Dr. DuPont (Jones et al., 1991) also noted that viable but nonculturable bacteria are a real and significant phenomenon when they report that "The results indicate that non-culturable coccal forms of *C[ampylobacter] jejuni* are capable of infecting mice but that this property may differ between strains." Dr. DuPont further cites another reference, in which he is one of the authors (Mathewson et al., 1983) which states "In this country, at least two large waterborne outbreaks have been reported, affecting ca. 4,300 people (3,7). In these outbreaks, *C. jejuni* was implicated by its isolation from individuals with diarrhea, but the organism could not be isolated from the incriminated water sources." Therefore, the Defendants' own expert agrees, consistent with what is available in the scientific literature, that it is not always possible to isolate the organisms from a water source, even when they are unequivocally known to be present.

18. While the U.S. EPA and other entities have on occasion organized workshops and convened scientific meetings to discuss the issue of bacterial water quality measures and the use of various methods to assess such water quality (e.g., U.S. EPA, 2007), those organizations and work groups have yielded only suggestions and potential alternatives. Multiple deadlines for tangible revision of bacterial regulations, bacterial water quality criteria and assessment methods in the past have been proposed, have not been met, and have been reproposed with extended timeframes. This pattern clearly illustrates the difficulty and the controversy that is associated with attempting to replace or improve upon the existing "indicator organisms" system. To date, no viable alternative has been agreed upon or implemented, and the existing system remains in place both at the federal and state levels. Thus, while there are always criticisms of an existing system, there is not a "new plan" afoot, nor is that imminent. Further, there is consensus that the presence of these indicator organisms at levels greater than the health-based criteria or standards set for them represents a significant human health threat.

19. The Oklahoma State Department of Health (OSDH) maintains statistics regarding specific reportable diseases including diseases caused by bacteria such as *Campylobacter*, *Salmonella*, and *E. coli* 0157:H7, and by microscopic parasites such as *Giardia* and *Cryptosporidium*. These organisms have been associated repeatedly in the scientific literature with poultry waste and often are also associated with contaminated drinking water, fecal material, and contact with birds. An evaluation of OSDH records for Oklahoma counties in the IRW shows that Adair County consistently reported rates of campylobacteriosis considerably in excess of the state average for the period 1997 to 2007 (OSDH, 2006; OSDH, 2007; OSDH, 2008). In addition, rates of salmonellosis reported in the time period of 1990-2007 also regularly have exceeded the average statewide incidence rate in Adair, Sequoyah and Cherokee Counties. The rate of salmonellosis in Sequoyah County was reported to exceed the state incidence rate for all except three years during the period 1990 to 2001 (OSDH, 2006; OSDH, 2007; OSDH, 2008).

20. Notwithstanding the statistics that are compiled and maintained by the OSDH, identification of individual illnesses is not a prerequisite to positing a reasonable likelihood of significant human health risk from bacterial contamination in the IRW.

While the OSDH has not investigated any "outbreaks" with regard to the diseases discussed above, it can not and should not be presumed that incidents of infection are not occurring. When using the CDC's guidelines for investigating an outbreak, a "clustering" of sickness must take place to warrant an investigation. This would be very difficult to identify for several reasons. First, there are a large number of groundwater wells in the IRW, but these wells are well-dispersed through the region and impacts to groundwater would be difficult to link to <u>specific</u> instances of waste spreading. Second, under recreational surface water use circumstances, recognizing that many tourists visit the Illinois River watershed from Arkansas, Kansas, and Missouri, as well as other counties in Oklahoma, the likelihood of identifying clusters of affected individuals would be very low if sickness occurred. Lee et al. (2002) correctly noted that outbreak investigations were increasingly difficult to document when users convene onto one venue and then geographically disperse. This illustrates one highly plausible explanation for why no focused investigations have been initiated for the IRW. Latency periods on the order of a day to a week (Mayo Clinic, 2008; CDC, 2008), depending on the bacterium, would surely affect reporting statistics if recreational users and tourists to the region are taken into account, and consideration is given to the likelihood of returning to their homes after visiting the IRW.

21. One allegation made repeatedly in this case has been the observation that food is the dominant, and arguably the only important, source for infection and human disease outbreaks. I have pointed out a number of reasons in my report and my previous testimony explaining why this is not true, but a very recent publication (Denno et al., 2009) confirms and extends that conclusion. The Denno et al. (2009) paper studied "childhood sporadic reportable enteric infection (REI) caused by bacteria, specifically *Campylobacter, Salmonella, Escherichia coli* O157, or *Shigella* (REI-B)." The authors demonstrated that "non-food exposures were as important as food-related exposures", and that recreational water exposure (e.g., swimming, playing) contributed the greatest risks to children among the non-food exposures categories. The authors point out that, while some disease <u>outbreaks</u> in the past have been tied to recreational water exposure, this represents the first study to identify such an association for "sporadic microbiologically confirmed" reportable enteric infections. The authors also noted that the magnitude of this association was "surprisingly large."

22. It is clear that many bacterial diseases are commonly under-reported, given the limitations of the passive disease surveillance systems presently in place in Oklahoma and elsewhere. Multiple factors play a role in whether disease outbreaks or events are recognized, investigated, and/or reported, which typically will result in under-reporting of the true illness rate (Lee et al., 2002; Blackburn et al., 2004; Liang et al., 2006; Craun & Calderon, 2006;). Multiple studies (Lee et al., 2002; Yoder et al., 2004; Blackburn et al., 2004; Liang et al., 2006) have concluded that data which are collected most commonly pertain to "outbreaks," with no mechanism to include seemingly sporadic cases, and therefore the data do not necessarily represent actual endemic trends with waterborne illnesses. This is of special concern in the case of what are termed "sensitive populations", including the elderly, young children, those with immune system compromise, and those with chronic disease (Reynolds et al., 2008). The observations already available concerning disease occurrence in northeastern Oklahoma underscore the potential for increases in infectious diseases related to land disposal of poultry waste in large quantities.

23. Bacteria of human health significance, including *Campylobacter, Salmonella, Staphylococcus*, *Escherichia coli* and other important species, as well as bacterial indicator organisms such as fecal coliforms and enterococci, are present in poultry waste (Barbour and Nabbut, 1981; Kazwala et al., 1990; Kelley et al., 1995; Coyne and Blevins, 1995; Stern et al., 1995; Kawano et al., 1996; Gregory et al., 1997; Terzich et al., 2000; Allos, 2001; Jones, 2001; Thaxton et al., 2003; Hartel et al., 2005; Jenkins et al., 2006; Line and Bailey, 2006; Vadari et al., 2006; CDM, 2007; PCIFAP, 2008). Land spreading of poultry waste has long been recognized as a major bacterial contamination source in the environment (Crane et al., 1980; Adamski, 1987; Adamski and Steele, 1988; Hill et al., 2005; PCIFAP, 2008). Spreading of waste material, a traditional agricultural waste disposal practice, becomes a major source of contamination because frequently it exceeds the rate at which wastes can be accommodated by or processed in agricultural ecosystems (Coyne and Blevins, 1995). Rainfall, specifically when it occurs shortly after land spreading, may then result in pathogen distribution by runoff from spread poultry waste or by leaching through the soil profile (Giddens and Barnett, 1980; Gagliardi and Karns, 2000; Fisher, 2008; Mishra et al., 2008; Olsen, 2008), even if buffer zones are used correctly, which they frequently are not. This is rendered even more important by the fact that the recreational season for the IRW overlaps with and immediately follows the rainy season (Caneday, 2008), a period which is well within the survivability duration of the bacteria in question. The environmental survivability of bacteria in soil, surface water and even treated water, can be on the order of several days to many months (Jamieson et al., 2002; Cools et al., 2003; Tetra Tech, 2004; Davis et al. 2005; Fricker, 2003). Runoff from waste-spread fields often carries excess nutrients, pollutants, and pathogens to nearby waterways, which can negatively affect surface water, groundwater, aquatic life, and human health. Even months after land application of poultry waste, fecal coliforms and *E. coli* can be resuspended from sediments and transported downstream (Coyne and Blevins, 1995; Hartel et al., 2000; Davis et al., 2005; Ringbauer et al., 2006).

24. In contrast to claims by some of Defendants' experts, a fate and transport analysis has been conducted demonstrating the environmental contamination from poultry waste at each environmental step addressing fate of poultry waste and selected components following generation and disposal. This process goes from waste generation at the poultry houses, to edge of agricultural fields where waste is applied, to the potential for leaching to groundwater and running off into streams, rivers, and waters and sediments of Lake Tenkiller. This analysis supports and is consistent with my opinions concerning the risks associated with the land application of well over 300,000 tons (over 6 million pounds) of poultry waste each year in the IRW. The expert reports of Drs. Fisher, Engel, Olsen and Harwood, as well as detailed evidence cited therein, also illustrate the fate and transport work done in this case. As an adjunct to that, other recent research drawn from the scientific literature (e.g., Brooks et al., 2009) demonstrates the phenomenon of microbial runoff from land applied poultry litter and waste following simulated rainfall events.

25. My report (Teaf 2008) included a bacterial source analysis of fecal coliforms for the six counties which share some portion of the IRW (Adair, Cherokee, Delaware and Sequoyah in OK; Benton, Washington in AR). That analysis was conducted according to procedures employed and assumptions derived from standard approaches used in Total Maximum Daily Load (TMDL) evaluations at the state and federal levels (e.g., ODEQ, undated; U.S. EPA, 1997; U.S. EPA, 2001). That analysis considered fecal coliform contributions from a variety of categories for which data were available, including: domestic pets, deer/wildlife, failing septic systems, permitted point sources (i.e., NPDES outfalls), and livestock. The livestock category was further subdivided into groups by poultry, cattle/calves, horses/ponies, sheep/lambs, and swine. The numerical values for each category are expressed in units of Colony Forming Units per day (CFU/day). For example, the total fecal coliform load from poultry and from cattle/calves is approximately 5 x 10^{15} CFU/day, or 5,000,000,000,000,000 CFU/day each. Several important conclusions can be drawn from this source contribution analysis, including the following:

- The categories of domestic pets, deer/wildlife, failing septic systems and point sources each contribute from 0.01% to 0.9% of total fecal coliform loading. Those contributions are not significant in comparison to the contribution from livestock;

- The livestock category alone contributes nearly 99% of total fecal coliform loading;

- Within the livestock category, poultry and cattle/calves each contribute just over 40% each of the total, swine contribute about 14% of the total, sheep/lambs contribute about 0.1% of the total, and horses/ponies contribute about 0.03% of total fecal coliform loading.

26. At its simplest, the information to date, as summarized in this report and others, reveals that land applied poultry waste in the IRW is a significant and substantial source of phosphorus and bacteria. My position is not, and never has been, that poultry raising operations represent the sole source of bacteria and nutrients in IRW waters, but such operations certainly represent a significant and substantial source. That conclusion is based on the amount of waste generated, how it is managed (a significant proportion of the waste generated is land applied in the IRW), the time period over which such waste was generated and disposed in the IRW, and links between biochemical markers in specific bacterial species from poultry waste and environmental samples. Furthermore, Dr. Fisher studied the geology of the IRW to determine how poultry waste can be transported in the environment based on the karst, fractured geology, and the studies or tests demonstrating runoff and leaching of poultry waste constituents from land-applied fields. In addition, the State's experts have conducted extensive sampling in the IRW. Taking into consideration all of that information, the existing data and ongoing sampling by the USGS and other entities, as well as previously published governmental reports and the work done by university investigators, the State's experts, including Drs. Fisher, Engel, Olsen and Harwood, studied the constituents of poultry waste and the movement of those constituents at each step along the pathway. This begins with the waste generation and field application, edge of field sampling, and evaluation of the sediments, springs, groundwater and surface water of the IRW, including Lake Tenkiller.

27. Dr. Harwood's findings that a poultry litter-specific biomarker (PLB) is found in all environmental compartments tested in the IRW, from soil samples, to edge-of-field samples to surface water and groundwater decisively links a large portion of the indicator bacteria contamination to land applied poultry waste in the IRW. The PLB work conducted by Dr. Harwood meets or exceeds the standards established in practice and in the microbial source tracking scientific literature (e.g., Stoeckel and Harwood, 2007; Scott et al., 2002; U.S. EPA, 2005; Santo Diomingo and Sadowsky, 2006) in terms of sensitivity, specificity and extensive validation (Harwood, 2009).

28. Water samples collected by the U.S. Geological Survey (USGS) and the Oklahoma Scenic Rivers Commission (OSRC) at a variety of locations in the IRW in 2008 continue to show large single sample exceedances of "indicator organisms" (fecal coliforms, *E. coli* and enterococci) at a number of locations within the IRW. At two of the six USGS sampling locations, detectable levels of *Salmonella* also were found. March and April 2009 USGS sampling events showed exceedances of one or more of the indicator organisms. *Salmonella* was detected at two of those locations. Thus, the trend in bacterial exceedances continues and it will continue until actions are taken to decrease the contribution of bacteria from land applied poultry waste within the IRW.

29. Several of the Defense experts have concluded that the IRW is not meaningfully different from other waterbodies in Oklahoma or around the country in terms of bacterial levels (e.g., Sullivan 2009a Deposition, p. 292; Sullivan 2009b Report, p. 19; Sullivan 2008 Declaration, Section D; Connolly 2009 Report, Section 6; DuPont 2008 Report, p. 8), a conclusion that cannot legitimately be reached given the erroneous calculation and evaluation methods used. More importantly, they make no specific effort to ascribe bacterial sources to the individual waterbodies in the state, or elsewhere, which they cite. This is a critical point, because while numerical bacterial levels may be similar among one or more waterbodies, their sources from location to location may be, and likely are, different. In one area, the principal source may be poultry waste, in another it may be urban runoff, in another it may be sewage treatment effluent. In terms of the risk posed by PBCR uses of streams in the IRW, only bacterial data from the IRW are probative. It is irrelevant and potentially misleading to point to values observed elsewhere in Oklahoma as being useful in an assessment of IRW risks posed, just as it is irrelevant what levels may be observed in Pennsylvania, or Texas, waterbodies. This is especially true given the demonstrated high degree of recreational use occurring in the IRW, which emphasizes the importance of ensuring that the waters there are safe.

III. My opinions regarding human health risks associated with disinfection byproducts (DBPs) and cyanobacteria growth related to land applied poultry waste are well-founded and supported by reliable tests.

A. The identification of poultry waste as a source of organic matter and the subsequent formation of DBPs is based on reliable science.

30. As illustrated in my expert report and ancillary materials, there has been an increase in the poultry population in the IRW and, thus, an increase in the amount of waste generated by poultry (GAO, 2008), dating back as far as about 1950 (Engel, 2008; Fisher, 2008). In addition, Engel (2008) has concluded that close to 80% of the net annual phosphorus contribution to the IRW comes from poultry. High levels of phosphorus in runoff act to provide necessary nutrients and "fertilize" the aquatic life, leading to increases in organic matter, and excessive growth of algae or underwater plant, all of which are well-recognized as sources or substrates for increased production of disinfection byproducts (DBP's; e.g., Hoehn et al., 1980; Dore et al., 1982; Lee and Jones, 1991; Chow et al., 2007; Chen et al., 2008; Diaz et al., 2008). This increased organic matter, in conjunction with excessive nutrient levels, primarily nitrogen and phosphorus, from poultry waste are some of the principally recognized causes of eutrophication, algal growth, and resultant water quality degradation (Lee and Jones, 1991; Carpenter, 2005; Cooke and Welch, 2008; Havens, 2008; PCIFAP, 2008). As discussed in Paragraphs 30 through 34, the formation of DBPs, both in terms of Trihalomethane Formation Potential (THMFP) and as measured in DBP concentrations in water distribution systems, is consistently demonstrable in water supplies drawn from the IRW.

31. As discussed, the principal source of phosphorus to Lake Tenkiller has been attributed to poultry waste that historically has been applied to pastures, and which eventually reaches the Illinois River and then Lake Tenkiller (Engel, 2008; Cooke and Welch, 2008). One of the most effective methods for controlling eutrophication and restoring water quality is to reduce the excessive phosphorus sources (Sas et al., 1989; Lee and Jones, 1991; Slaton, 2004; Cooke and Welch, 2008), which in this case could be accomplished by decreasing or eliminating the contribution made by poultry waste. I have demonstrated the characteristic increased nutrient supply, including that from poultry waste, as a source of algae and other organics related to increased production of DBPs in the IRW. I have not attempted to construct a complete list of contributors to organic matter found in the waters of the IRW. Rather, I have used reliable science and credible supporting information to determine that poultry waste is a significant source of DBPs and organic matter in the IRW.

B. Comparing analytical data to MCL's, MCLG's and risk-based health screening levels is a reliable and accepted approach.

32. The levels of DBPs, including trihalomethanes (THMs) and haloacetic acids (HAA5s), were compared with the Maximum Contaminant Level (MCL) values that were established in the 1998 Stage 1 Disinfectants and Disinfection Byproducts Rule which were then upheld with sampling frequency changes in the Stage 2 Disinfectants and Disinfection Byproducts Rule in 2006 (U.S. EPA, 1998; U.S. EPA, 2006). The MCLs imposed by the Stage 2 DBP rule are, by definition, based upon a combination of considerations regarding health effects, technical feasibility and costs, the latter two of which have nothing to do with health protection, but rather address ease of reaching certain target levels. In contrast, the development of Maximum Contaminant Level Goals (MCLGs) is based on health effects considerations only. For example, the MCLG for chloroform is 0.07 mg/L, while the MCL for total THMs, which typically are dominated by chloroform, is 0.08 mg/L. The MCLGs for two common HAA5s monochloroacetic acid and trichloroacetic acid, are 0.07 mg/L and 0.02 mg/L, respectively, while the current MCL for HAA5s is 0.06 mg/L. For other DBPs (e.g., bromodichloromethane, bromoform, and dichloroacetic acid), the MCLG is zero, reflecting the ideal health-based agency position that potential carcinogens should not be present in drinking water at any concentration. The non-health-based consideration of cost to correct a situation, and the technical feasibility of available correction approaches, are not included in that strictly health-based evaluation.

33. In addition to the comparisons with MCLs and MCLGs, a comparison was conducted using standard risk-based screening levels (RBSLs). The RBSLs have been established by U.S. EPA as a means to evaluate site data for soils, water and air under assumptions of unrestricted (e.g., continuous) exposure (U.S. EPA, 2009), and under standard assumptions for acceptable health risk (e.g., one-in-one-million excess cancer risk, or 10^{-6}).

34. Comparing the measured water concentrations of DBPs to the MCLs, as well as to the fully health-based MCLGs and to the risk-based screening levels is a reliable and acceptable risk assessment method to evaluate the likelihood and the magnitude of human health risk even though they may not all be enforceable drinking water standards.

C. Comparing Trihalomethane Formation Potential (THMFP) to the MCL value for THMs is a relevant and appropriate comparison.

35. Trihalomethane Formation Potential (THMFP) represents a measure of the propensity for organic matter of all types in the raw water supply to form THMs during the chlorination process in the domestic water treatment plant. Although the THMFP method often is conducted using higher than average defined chlorine concentrations, it is a common screening technique commonly used to indicate the likelihood of subsequent formation of THMs in drinking water. Comparing the THMFP to the MCL values for THMs is not an error. It is known that THMs are produced during the chlorination of water. Methods to determine the potential for forming THMs are standard and useful in evaluating water treatment processes or water sources, and for predicting THM concentrations in a particular water distribution system (Standard Methods, 2009). The THMFP analysis may not represent the actual concentration of THMs that will be found in the drinking water, but it is a widely used technique for predicting the formation of those THMs based on the amount of organic matter present in the raw water samples.

D. The evaluation of cyanobacterial numbers and associated risk in the waters of the IRW was based on reliable evidence and scientific methodology.

36. The growth of potentially toxic cyanobacteria ("blue-green algae"), is well-recognized to be enhanced by increased nutrient loading of surface water bodies with phosphorus and other nutrients from agriculture and wastewater (QWQTF, 1992; WHO, 1999; Chorus et al., 2000; Kotak et al., 2000; WHO, 2000; Burgess, 2001; Briand et al., 2003; Gobler et al., 2007; Health Canada, 2007; Cooke and Welch, 2008). Stevenson (2008) found the nutrient concentration along the streams of the Illinois River Watershed to be high and to be directly related to poultry house density in the area. Eutrophication, which is the biological response to the excess of nutrients in a water body, has been identified as a major water quality management issue in a number of countries (Codd, 2000; Cooke and Welch, 2008). Prevalence and growth of cyanobacteria, a group which contain about 50 species of "harmful blue-green algae" that are known to produce potentially dangerous algal toxins (Sivonen and Jones, 1999), is closely tied to elevated nutrient levels. As noted in Chorus et al. (2000), "Cyanobacterial toxins occur naturally, but pollution with nutrients from agriculture and domestic wastewater has led to increased fertilization (eutrophication) of many water bodies". When turbulence of the water column is low, cyanobacteria can build up dense populations based on temperature profiles, the nutrients present, and their ability to control cell buoyancy, thereby controlling their vertical position in the water column to optimize their growth conditions (Steinberg and Hartmann, 1988; Duy et al., 2000). As noted by Falconer and Humpage (2005), "There is a strong relationship between phosphorus concentration in the water and cyanobacterial numbers and also a similar though less linked relationship between dissolved nitrate/ammonia and cyanobacteria".

37. WHO (1999) guidelines are widely used in the public health community to evaluate potential risks that may be posed by cyanobacteria in water supplies. The WHO guidelines state that at a density less than 20,000 cells/mL of cyanobacteria there exists relatively low risk of adverse human health effects, while at or above 100,000 cells/mL there is moderate risk and, when visible scum of cyanobacteria is present, there is high risk of adverse health effects. Pilotto et al. (1997) has suggested that these guidelines, while they are commonly employed, may not in and of themselves be adequate to protect health of recreational populations, and those authors noted that the frequency of health risks increased at cell densities as low as 5,000 cells/mL. The propensity of some non-scum-forming species to generate high cyanotoxin concentrations in water (e.g., 200 ug/L for *Planktothrix*) illustrates the peril in only associating high risk with the presence of scums (WHO, 1999; Chorus et al, 2000).

38. In water bodies that are governed by the PBCR requirements, such as those in the IRW, the State of Oklahoma mandates that such water bodies "shall not contain chemical, physical or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings" (OAC, 2007). Toxins and irritants produced by some cyanobacterial species fit that prohibition, and include anatoxins and saxitoxins (nervous system poisons), as well as microcystins, nodularins and cylindrospermopsins, all of which are toxic to the liver (Carmichael et al., 2001). Approximately 50% of all blue green algal blooms contain toxins (Lambert et al., 1994; Duy et al., 2000; Stone and Bress, 2007), and microcystin, a liver toxin, has been detected in Lake Tenkiller during sampling on behalf of the U.S. Army Corps of Engineers (Lynch and Clyde, 2006). The chances of contracting illness from these toxic cyanobacteria have been reported to increase with increasing algal bloom density and often increase toward the end of a season when cells have reached greater density and then may encounter unfavorable environmental conditions, may "lyse" (burst), and release their toxins (Dittmann and Wiegand, 2006). The presence of cyanobacteria also can cause taste/odor problems from a number of chemicals they release, such as geosmin and methylisoborneol (Watson et al., 2003; Tung et al., 2004; Izaquirre and Taylor, 2007; Uwins et al., 2007; Juttner, 2007; Xie et al., 2007; Cooke and Welch, 2008). Further, it has been demonstrated that the cyanobacterial toxins easily can pass through a number of drinking water treatment technologies in unaffected fashion (Burgess, 2001). Also as stated in Burgess (2001), "Besides ingestion from drinking water, humans come into contact with blooms through swimming, boating, and shoreside activity." In addition to requiring that water bodies be free of toxic materials, according to the Oklahoma Administrative Code (OAC) 785:45-5-19 (regarding surface water supplies): "The water must also be free from noxious odors and tastes, from materials that settle to form objectionable deposits, and discharges that produce undesirable effects or are a nuisance to aquatic life" (OAC, 2007).

39. The measurement of "chlorophyll a" (Chl) concentration is used as another indicator of abundance of algal growth (including cyanobacteria) in water bodies. Cooke and Welch (2008) noted that the probability of cyanobacteria "blooms" rise sharply when mean summer Chl concentration is above 10 ug/L. Existing regulations [OAC 785:45-5-10 (7)] describe numerical criterion for Chl as "The long term average concentration of chlorophyll-a at a depth of 0.5 meters below the surface shall not exceed 0.010 milligrams per liter" in Lake Tenkiller (OAC, 2007). Results from CDM sampling at four locations on Lake Tenkiller show that this long-term average criterion was exceeded during 2005-2006 at two of the four locations sampled with the long-term averages of 15.9 and 27.1 mg/L at LK-03 and LK-04, respectively (CDM, 2007).

40. The health-based WHO (1999) cyanobacteria guidelines were discussed previously in Paragraph 35. Results from sampling by CDM (2006, 2007) and OWRB and U.S. Army Corps of Engineers (ACoE, 2004; ACoE, 2005; OWRB, 2007) from several different locations on Lake Tenkiller during August 2004 through August 2007 showed that approximately 58% of all samples (233/404) exhibited cyanobacterial densities of greater than 20,000 cells/mL. In addition, approximately 24% (55/233) of those samples that were greater than 20,000 cells/ml also exceeded 100,000 cells/mL (moderate risk), and one June 2006 sample exceeded 1,000,000 cells/mL. The proportion of samples representing "moderate risk" clearly satisfies the RCRA Section 7003 demonstration of imminent and substantial endangerment, given that it is required only to show threatened or potential harm. WHO (1999) and Chorus et al. (2000) note that the "moderate risk" definition includes "potential for long-term illness" and "short-term adverse health outcomes." The difference between moderate and high risk is only with respect to "potential for acute poisoning" in the latter category.

IV. Conclusions

41. In the development of my opinions for this case, I have relied on a great deal of data collected from many different dependable sources and several different state, national and international agencies (e.g., State of Oklahoma, U.S. EPA, U.S.

Geological Survey, World Health Organization) to evaluate the presence and magnitude of indicator bacteria, cyanobacteria (potentially toxic blue-green algae) and disinfection byproduct levels. I have compared them to standard regulatory values in order to determine potential risks associated with exposure to surface water and drinking water in the IRW. In that evaluation, I have employed standard and accepted approaches which are consistent with the state of contemporary health risk assessment practice. While it is possible to take issue with my conclusions, that is the nature of scientific discourse.

42. The bacterial risk estimates are expressed in standard values for indicator organisms, as are the comparisons, while the disinfection byproducts evaluation relies on comparison with maximum contaminant levels (MCLs) and more strictly health-based risk numbers. The cyanobacterial comparisons are based on the World Health Organization (WHO) assessment criteria of low, medium and high risk. Looking at these three categories individually indicates that human health risks for each of them are significant and, if present together, the aggregate risks are likely to be greater than is estimated on an individual risk basis. It remains my professional opinion that land application of poultry waste contributes in a substantial way to these potential risks.

43. I declare under penalty of perjury, under the laws of the United States of America, that the foregoing is true and correct.

Christopher M. Teaf

Christopher M. Teaf, Ph.D.

4 June 2009

Date

ATTACHMENTS

Attachment A

CURRICULUM VITAE

NAME:	Christopher Morris Teaf
DATE OF BIRTH:	5 May 1953
PLACE OF BIRTH:	Philadelphia, PA
HOME ADDRESS:	3527 Trillium Court Tallahassee, FL 32312 (850) 668-4303
MARITAL STATUS:	Married, two children
PROFESSIONAL POSITIONS:	Associate Director Center for Biomedical & Toxicological Research and Waste Management Florida State University 2035 East Paul Dirac Drive Suite 226 HMB Tallahassee, FL 32310 (850) 644-5524 phone (850) 574-6704 FAX cteaf@fsu.edu *email* President & Director of Toxicology Hazardous Substance & Waste Management Research, Inc. 2976 Wellington Circle West Tallahassee, FL 32309 (850) 681-6894 phone (850) 906-9777 FAX cteaf@hswmr.com *email*
EDUCATION:	Ph.D. Toxicology, 1985 *University of Arkansas for Medical Sciences (UAMS)* M.S. Biological Science, 1980 *Florida State University (FSU)* B.S. Biology, 1975 *Pennsylvania State University (PSU)*
PROFESSIONAL MEMBERSHIPS:	Academy of Toxicological Sciences Florida Bar, Environmental and Land Use Law Section National Association of Environmental Professionals National Association of Underwater Instructors Society of Toxicology Society for Environmental Toxicology and Chemistry Society for Risk Analysis
CERTIFICATIONS	Fellow, Academy of Toxicological Sciences

Attachment A

ACTIVITIES & HONORS:

Senior Editor for Human Risk Assessment, international journal *Human & Ecological Risk Assessment*, published by Taylor & Francis. 2004 to present (*Editorial Board, 2000 to 2004*).

District 2 Local Emergency Planning Committee, Florida Emergency Response Commission, 1987 to present (*Vice Chair, 1991*).

Board Certified as a Fellow, Academy of Toxicological Sciences. 2009 to present.

Editorial Board, international journal *Environmental Forensics*, Taylor & Francis Publishers 2006 to present.

Advisory Board, Center for Terrorism & Public Health, Florida State University College of Medicine. 2001 to present.

Board of Directors, Dog Island Conservation District. 2002 to present (*Chair, 2004 to present*).

Science Advisory Board, 25th International Conference on Contaminated Soils, Sediments & Water, 2009. Amherst, MA.

Science Advisory Board, 24th International Conference on Contaminated Soils, Sediments & Water, 2008. Amherst, MA.

Science Advisory Board, 23rd International Conference on Contaminated Soils, Sediments & Water, 2007. Amherst, MA.

Science Advisory Board, 22nd International Conference on Contaminated Soils, Sediments & Water, 2006. Amherst, MA.

Science Advisory Board, 21st International Conference on Contaminated Soils, Sediments & Water, 2005. Amherst, MA.

Editorial Board, international journal *Soil & Sediment Contamination*, CRC Press, LLC. 2002 to 2006.

Science Advisory Board, 20th International Conference on Contaminated Soils, Sediments & Water, 2004. Amherst, MA.

Courtesy Professor, Department of Geology, Florida State University. 1999 to present.

Science Advisory Board, 19th International Conference on Contaminated Soils, Sediments & Water. Amherst, MA. 2003.

Science Advisory Board, 18th International Conference on Contaminated Soils, Sediments & Water. 2002. Amherst, MA.

Co-Director, NATO Advanced Research Workshop on Risk Assessment and Water Issues in Central Asia. 2000 to 2003. Almaty, Kazakhstan. 2000 to 2003.

Science Advisory Board, 17th International Conference on Contaminated Soils, Sediments & Water. 2001. Amherst, MA.

Advisory Board, Int'l Congress on Petrol. Contaminated Soils, Sediment & Water. London. 2000-2001.

Attachment A

Science Advisory Board, 16th International Conference on Contaminated Soils, Sediments & Water. 2000. Amherst, MA.

Assistant Scoutmaster, Troop 44. Tallahassee, FL. 1998 to 2004.

Editorial Board, *Environmental Toxicology & Chemistry*, published by CRC Press, LLC. 2003-2005.

Petroleum Underground Storage Tanks Technical Advisory Committee, Florida Department of Environmental Protection. 1996 - present.

Science Advisory Board, 15th International Conference on Contaminated Soils, Sediments & Water. Amherst, MA. 1998-1999.

Toxic Substances Advisory Council, Florida Department of Labor. 1990-2000 (*Chair, 1991-1996*).

Florida Bar, Environmental and Land Use Law Section Faculty and Steering Committee, 1996 - 1997.

Safety Committee, Florida Department of Environmental Protection, 1995 – 1997 (*advisor 1995-present*).

Florida Bar, Environmental and Land Use Law Section Faculty and Steering Committee, 1993 - 1994.

Technical Advisory Committee, MGP '95 - International Symposium on the Cleanup of Manufactured Gas Plant Sites. Prague, Czech Republic, 1994 to 1995.

Florida Comparison of Environmental Risks Project, 1994-1995 (*Human Health Co-chair*).

Landfill Technical Advisory Group, Florida Department of Environmental Protection, 1993-1994.

Benlate Health Effects Committee, Pesticide Review Council, Florida Department of Agriculture & Consumer Services, 1993-95.

Technical Advisory Committees for Budapest '92, Budapest '94, Warsaw '96, Warsaw '98, Prague 2000, Prague, 2003; 1st, 2nd, 3rd, 4th , 5th, and 6th International Symposia on Environmental Contamination in Central & Eastern Europe. 1991-2004.

Governor's Financial & Tech. Advisory Committee, Florida Dept. of Environ. Protection. 1986-1992.

Radon Measurement Specialist (*FL HRS Certification R1032*), 1989 to present.

Technical Referee: Human & Ecological Risk Assessment (*1999-present*); Nonlinearity in Biology, Toxicology and Medicine (*2005-present*); Ohio Journal of Science (*1988-1992*); Bulletin of Marine Sci. (*1994-1998*); Environmental Toxicology & Chemistry (*1997-present*); Environmental Biology of Fishes (*1987-1990*), Soil & Sediment Contamination (*2002-present*), Environmental Forensics (*2006-present*).

Director, Tallahassee Marathon/Half Marathon, 1989, 1990, 1991, 1995.

Outstanding Research Award, University of Arkansas Medical School, 1984.

Who's Who Among American College Students, 1983.

Graduation With Honors, Pennsylvania State University, 1975.

National Merit Scholar Program, 1971.

Eagle Scout, l969 (Troop 1, Boy Scouts of America; Paoli, PA; Assistant Scoutmaster 1971 to 1975)

Attachment A

SUMMARY OF ACTIVITIES

Dr. Teaf received a BS (Biology) from Penn State and MS (Biological Science) from Florida State University. He earned a Ph.D. (Toxicology) from the University of Arkansas for Medical Sciences and conducted his research at the National Center for Toxicological Research. His experience includes positions of Associate Director, FSU Center for Biomedical & Toxicological Research and Hazardous Waste Management since 1983, and Director of Toxicology for HSWMR, Inc. since 1985 (President since 1989). From 1980 to 1982 he served as Research Staff for the Governor's Hazardous Waste Policy Advisory Council.

Areas of research and professional activity include: toxicological risk assessment for exposure to occupational and environmental chemicals under requirements of OSHA, CERCLA, SARA, RCRA, TSCA, and related state or federal legislation; modification of mutagenicity by environmental factors; effects of drugs and alcohol, male reproductive toxicology, aquatic toxicology, and waste management. Dr. Teaf has served as peer reviewer for: Human & Ecological Risk Assessment; Risk Analysis; Environmental Forensics; Nonlinearity in Biology, Toxicology and Medicine; Environmental Toxicology & Chemistry; Integrated Environmental Assessment & Management; Bulletin of Marine Science; Ohio Journal of Science; Chemosphere; Environmental Biology of Fishes, reviews of research or proposals submitted to the Agency for Toxic Substances and Disease Registry (ATSDR), and various invited book chapter reviews. He is on Editorial Boards for Soil & Sediment Contamination and Environmental Forensics, and is Senior Editor for Human Risk Assessment for Human & Ecological Risk Assessment.

He has directed or conducted research for the U.S. Environmental Protection Agency (USEPA), U.S. Department of Agriculture, and several agencies in Florida, including: Department of Labor, Department of Environmental Protection (FDEP), Department of Health (FDOH), and Department of Community Affairs. He served as toxicologist to the Governor's Financial & Technical Advisory Committee (1986-1992), and for the state Landfill Technical Advisory Group (1993-1994). He presently serves as toxicologist for the state Petroleum Underground Storage Tanks Technical Advisory Committee. He was Co-chair of the Human Health Committee, Florida Comparison of Environmental Risks Project, a cooperative study funded by USEPA, FDEP and other agencies. He served as Chair of the Toxic Substances Advisory Council for the Florida Department of Labor, which implemented the Florida Right-to-Know Law. Dr. Teaf is toxicologist for and served as Vice-Chair of the District 2 Local Emergency Planning Committee (State Emergency Response Commission). From 1986-1989, he was liaison between the State University System of Florida Toxicological Research Coordinating Committee and FDEP. He presently is involved in activities in the U.S. and abroad related to preventing chemical terrorism. From 1998-2005, Dr. Teaf was actively involved in the statewide Contaminated Soils Forum and a technical subgroup, the Methodology Focus Group. He has served on graduate committees at Florida A&M University and Georgia Tech.

Chris has taught graduate and undergraduate courses at Florida State University, Florida A&M, the University of Florida, and Georgia Tech. He has organized and participated in seminars and training courses for many groups including the World Health Organization (WHO), USEPA, U.S. Department of Agriculture, ATSDR, FDOH, Florida Engineering Society, Florida Bar Association, FDEP, Florida Department of Education, Florida Chamber of Commerce, National Conference on Waste Exchange and Resource Reuse, National Hazardous Materials Training Center, and American Bar Association. He has served on Advisory Committees for MGP '95 (International Symposium on the Cleanup of Manufactured Gas Plants; in Prague), and for the six International Symposia on Environmental Contamination in Central & Eastern Europe (Budapest, Warsaw, Prague), among others.

Dr. Teaf has provided technical services on toxicology, environmental and human health risk assessment, waste management, recycling, water quality, and occupational health/safety, particularly regarding OSHA Hazard Communication Standard, Florida Right-to-Know Law and federal requirements under RCRA, CERCLA, and TSCA or related state regulations, including CERCLA cost allocations. He has provided services to the U.S. Attorney, and Florida State Attorney, as well as Attorneys General of Florida, Washington and Oklahoma. Dr. Teaf has testified on environmental issues, alcohol/drugs, occupational exposures, chemical health effects, and toxicological risk assessment to regulatory, legislative and judicial bodies.

Attachment A

SUMMARY OF PROFESSIONAL POSITIONS:

Associate Director
Center for Biomedical & Toxicological Research and Waste Management
Florida State University (Tallahassee, FL)
1983 to present

Director of Toxicology
Hazardous Substance & Waste Management Research, Inc. (HSWMR; Tallahassee, FL)
1985 to present (President, 1989 to present)

Advisory Board
Center for Terrorism and Public Health
Florida State University College of Medicine
2002 to present

Adjunct Faculty
College of Pharmacy & Pharmaceutical Sciences
Florida A & M University (Tallahassee, FL)
1998 to present

Board Member
Dog Island Conservation District
Franklin County, Florida
2002 to present (Chair, 2004 to present)

Board of Directors
Southern Waste Information Exchange (Tallahassee, FL)
2000 to present (Chair, 2000 to 2004)

Associate in Medicine
Program in Medical Sciences / FSU Medical School
Florida State University (Tallahassee, FL)
1995 to 2002

Toxicologist
Toxic Substances Advisory Council
Florida Department of Labor & Employment Security (Tallahassee, FL)
1990 - 1998 (Chairman, 1992 to 1998)

Toxicologist
Petroleum Underground Storage Tanks Advisory Committee
Florida Department of Environmental Protection (Tallahassee, FL)
1996 to present

Toxicologist
District 2 Local Emergency Planning Committee
Florida Department of Community Affairs (Tallahassee, FL)
1987 to present (Vice Chairman, 1991)

Toxicologist
Florida Landfill Technical Advisory Group
Florida Department of Environmental Protection (Tallahassee, FL)
1993 - 1994

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Adjunct Faculty
Interdisciplinary Toxicology Program
University of Arkansas for Medical Sciences (Little Rock, AR)
1986 - 1989

Toxicologist
Governor's Financial and Technical Advisory Committee
Florida Department of Environmental Regulation (Tallahassee, FL)
1986 - 1992

Research Assistant
National Center for Toxicological Research and the University of Arkansas for Medical Sciences (Little Rock, AR)
1983 - 1985

Associate Director
Southern Waste Information Exchange (Tallahassee, FL)
1981 - 1983

Research Staff
Florida Governor's Hazardous Waste Policy Advisory Council
1980 - 1982

Research Associate, Hazardous Waste Management Program
Florida State University (Tallahassee, FL)
1979 - 1983

Teaching/Research Assistant
Departments of Biological Science and Oceanography
Florida State University (Tallahassee, FL)
1976 - 1980

Animal Technician
Wyeth Laboratories (Philadelphia, PA)
1975 - 1976

Attachment A

TEACHING EXPERIENCE:

Air Quality (*Indoor/Outdoor*)
Alcohol and Other Drugs
Aquatic Toxicology
Carcinogenesis and Carcinogens
Comparative Vertebrate Morphology
Dermal Toxicology
Emergency Response and Contingency Planning
Environmental Chemistry & Behavior of Chemicals
General Zoology
Hazardous Waste Management
Health and Safety for Site Investigation and Response Personnel (*40 Hr and 8 Hr*)
Ichthyology
Inhalation Toxicology
Industrial and Occupational Toxicology
Industrial Health & Safety
Metals Toxicology (*e.g., arsenic, lead, mercury, nickel, vanadium, cadmium, chromium*)
Mutagenesis
Nephrotoxicity
Airborne Particulates
Right-to-Know and Hazard Communication Laws (*OSHA and state*)
Pesticide Toxicology
Principles of Toxicology and Risk Assessment
Radionuclides and Radiation Toxicology
Reproductive Toxicology
Research Diving Techniques
Seafood Safety: Health Effects from Contaminated Products
Toxicology of Solvents and Other Organic Hydrocarbons
Toxicological Risk Assessment
Toxicology and Management of Mixed Wastes (*Chemical/Radiological*)
Toxicology for Physicians, Nurses, and Other Public Health Personnel

Courses listed represent those taught at Florida State University, University of Florida, University of North Florida, Florida A & M University, Georgia Institute of Technology and Tallahassee Community College. At Florida State University, Dr. Teaf has taught classes in the Departments of Biology, Chemistry, Engineering, Geology, Oceanography, and Urban & Regional Planning. Course coverage ranges from single day short courses to full semester graduate level and undergraduate level courses.

Attachment A

PUBLICATIONS AND SELECTED ABSTRACTS:

Griffin, T, and C.M. Teaf. 2009. Anthropogenic Background Analyses and Their Potential Impact on Brownfields Redevelopment Projects. Accepted for presentation at Environmental & Land Use Law Annual Meeting, Florida Bar Association. Amelia Island, FL. August, 2009.

McDevitt, T.M. and C.M. Teaf. 2009. Health Risk & Toxicology in Case Evaluation and Litigation: Gaining Maximum Benefit from Your Expert. Accepted for presentation, Environmental and Emerging Claims Managers Association (EECMA) Spring 2009 Conference, Captiva, FL. May, 2009.

Covert, D.J., K.F. Kosky, B.J. Tuovila and C.M. Teaf. 2008. Regulation of Hydrogen Sulfide (H_2S) at C&D Landfills: Health Risk & Esthetic Considerations. 24rd Annual International Conference on Soils, Sediments and Water. October, 2008. Amherst, MA. *(Also served as Session Moderator).*

Teaf, C.M. 2008. Safety in The Workplace: Recognition, Anticipation and Prevention. For the Florida Interagency Council on Safety and Loss. November, 2008.

Teaf, C.M., J.B. Fisher, M.M. Garber, V.J. Harwood, S.N. Norris and R.L. Olsen. 2008. Field Applied Poultry Waste: Toxicology. Microbial Issues & Health. 24rd Annual International Conference on Soils, Sediments and Water. October, 2008. Amherst, MA.

Teaf, C.M. 2008. Safety on the Job: Dealing With Obvious and Not-so-Obvious Workplace Hazards. For the Florida Department of Financial Services, Division of Risk Management. July, 2008.

Teaf, C.M., D.J. Covert and S. Kothur. 2008. Polycyclic Aromatic Hydrocarbons (PAHs) in the Urban Environment: A Florida Perspective. International Journal for Soils, Sediments and Water, Volume 2. *In press.*

Teaf, C.M. and B.L. Johnson. 2008. Deception and Fraud in the Publication of Scientific Research: Are There Solutions? International Journal for Soils, Sediments and Water, Volume 1.

Weeks, N., D. Jones, C.M. Teaf, T. Lubozynski and Petrovich, M. 2007. RBCA and Conditional Closure as a Brownfields Tool. 10th Annual Florida Brownfields Conference & Exhibition. November, 2007. Orlando, FL.

Teaf, C.M. and B.L. Johnson. 2007. Ethics in Technical Publications: How Can the System Identify and Address Scientific Fraud. 23rd Annual International Conference on Soils, Sediments and Water. October, 2007. Amherst, MA. *(Also served as Session Moderator).*

Teaf, C.M., D.J. Covert and S. Kothur. 2007. Urban Polycyclic Aromatic Hydrocarbons (PAHs): A Florida Perspective. 23rd Annual International Conference on Soils, Sediments and Water. October, 2007. Amherst, MA.

Teaf, C.M., D.J. Covert, R. M. Coleman, M. Petrovich, R.S. Murali, and V. Yarina. 2007. Risk Issues and Background Evaluation for Arsenic in Soil at a Planned Residential Development. Contaminated Soils, Sediment & Water. Volume 12: pp. 77-82. (*Also served as Session Moderator*).

Teaf, C.M. 2006. Disinfection byproducts: Benefits & limitations of existing drinking water guidelines. U.S. Environmental Protection Agency Federal-State Toxicology and Risk Analysis (FSTRAC) “Safe & Clean Water” Meeting. December, 2006. Clearwater, FL.

Khankhasayev, M., R. Herndon, J. Moerlins and C.M. Teaf. 2006. Overview of NATO CCMS Pilot Study on Environmental Decision-making for Sustainable Development in Central Asia. In: Vogtmann, H. and N. Dobretsov (eds.). Environmental Security and Sustainable Land Use – with special reference to Central Asia. Springer Publishers, NATO Security through Science Series. 379 pp.

Attachment A

Coleman, R.M., C.M. Teaf, V.P. Cavey, D.J. Covert, S.N. Hughes, M. Marcus, M. McClure. 2006. Achievement of a Beneficial Use Designation for a Specialized High Volume Byproduct. Contaminated Soils, Sediments and Water. Volume 11, Chapter 3, pp. 27-48. *(Also served as Session Moderator).*

Teaf, C.M. 2006. Arsenic bioavailability workshop: Physical and chemical characteristics of soils which influence decisions regarding arsenic bioavailability and health risks. EPRI Arsenic Work Group. December, 2006. Tampa, FL

Teaf, C.M. and B.L. Johnson. 2006. Fraud and deception in publication of scientific research: Is there a solution? Human and Ecological Risk Assessment 12(4): 623-625.

Teaf, C.M. 2006. Forward to Volume 11. *In:* Kostecki, P.T., and E.J. Calabrese (eds.), Proceedings of the 21st Annual International Conference on Soils, Sediments and Water. Amherst, MA. Soil & Sediment Contamination, Volume 11, pp ix - x.

Teaf, C.M., B. Merkel, H.M. Mulisch, J.M. Kuperberg, and E. Wcislo. 2006. Industry, mining and military sites: Potential hazards and information needs. *In:* Schmoll, O. et al. (eds.), Protecting Groundwater for Health: Managing the Quality of Drinking-water Sources (Chapter 11). IWA Publishers, London, UK. pp. 309-336.

Teaf, C.M., B. Merkel, H.M. Mulisch, J.M. Kuperberg, and E. Wcislo. 2006. Industry, mining and military sites: Control and protection. *In:* Schmoll, O. et al. (eds.), Protecting Groundwater for Health: Managing the Quality of Drinking-water Sources (Chapter 23). IWA Publishers, London, UK. pp. 613-630.

White, M., D. Rountree, K. Geis, S. Kastury, K. Taylor, J. Curtis, D. Covert, and C.M. Teaf. 2006. Cascades Park: Remediation and Beneficial Recreational Redevelopment of a Former Manufactured Gas Plant Site. 22nd Annual International Conference on Contaminated Soils, Sediments and Water. October, 2006. Amherst, MA.

C.M. Teaf, D.J. Covert, R. M. Coleman, M. Petrovich, R.S. Murali, and V. Yarina. 2006. Risk and Background Evaluation for Arsenic in Soil at a Planned Residential Development. 22nd Annual International Conference on Contaminated Soils, Sediments and Water. October, 2006. Amherst, MA.

Clark, B.S., P.T. Medico, F.J. Bermudez, M. Clewner, R.G. Wilkins, R.M. Coleman and C.M. Teaf. 2006. Beneficial Use of C&D Recovered Screen Material in Residential Applications: A Case Study. Soil & Sediment Contamination 11 (3): 355-360.

Teaf, C.M. 2006. A Toxicologist's Perspective on Industrial Exposures. Workers First Watch, Fall 2006. pp. 17-22. (*Originally published as a paper in Proceedings of the Annual Spring Conference & CLE for the Workers Injury Law & Advocacy Group. May, 2006. Lake Buena Vista, FL.*)

Teaf, C.M. and J.M. Kuperberg. 2006 Investigation and Information Collection for Contamination at Industrial Sites. *In*: Chorus, I. et al. (eds.), Monograph on Characterization and Mitigation of Surface Water Contamination. World Health Organization. *In editorial review for publication in 2006.*

Teaf, C.M. and J.M. Kuperberg. 2006 Critical Control Points and Prevention of Contamination for Industrial Sites. *In*: Chorus, I. et al. (eds.), Monograph on Characterization and Mitigation of Surface Water Contamination. World Health Organization. *In editorial review for publication in 2006.*

Teaf, C.M. and B.J. Tuovila. 2005. Indoor Air & Human Health: 21st Century Considerations. 8th Annual Florida Brownfields Conference. October, 2005. Jacksonville, FL.

Attachment A

Coleman, R.M., V.P. Cavey, D.J. Covert, S.N. Hughes, M. Marcus, M. McClure, and C.M. Teaf. 2005. Achievement of a Beneficial Use Designation for a Specialized High Volume Byproduct. 21st Annual International Conference on Contaminated Soils, Sediments and Water. October, 2005. Amherst, MA.

Clark, B.S., P.T. Medico, F.J. Bermudez, M. Clewner, R.G. Wilkins, R.M. Coleman and C.M. Teaf. 2005. Beneficial Use of C&D Recovered Screen Material in Residential Applications: A Case Study. 21st Annual International Conference on Contaminated Soils, Sediments and Water. October, 2005. Amherst, MA.

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Sixth International Symposium on Environmental Contamination in Central and Eastern Europe. Prague, Czech Republic. September, 2003. (*Session Moderator and Steering Committee Member*).

OSHA Refresher Course for University Health and Safety Activities (8 hours). For Florida State University. Tallahassee, Florida. June 11, 2003.

Statewide Video Conference on Chemical Terrorism. For Florida State University College of Medicine and Florida Department of Health. June 10, 2003.

Personnel Health and Safety Refresher Course (8 hours). For Florida Department of Environmental Protection. Tallahassee, Florida. May 7, 2003.

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Safety Concerns: Awareness for the Field Inspector. For Florida Department of Environmental Protection. St. Petersburg, Florida. August, 2002

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Control of Reportable Diseases in Florida: A Public-Private Partnership. For Florida Department of Health & Rehabilitative Services. Tallahassee, Florida. April 17, 1996.

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Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Protection. Tallahassee, Florida. April 2, 1996.

American Bar Association Section of Litigation, 8th Annual Environmental Litigation Midyear Meeting. Vail, Colorado. February 15-16, 1996.

12th Annual Environmental Permitting Short Course. For Florida Chamber of Commerce. Orlando, Florida. January 17-18, 1996.

1995 Conference on State of Practice of Risk Assessment in Human Health and Environmental Decision Making. Tallahassee, FL. December 13-14, 1995. (*Session Moderator and Steering Committee Member*).

Risk Assessments, Audits & Other Compliance Management Tools. Environmental Compliance & Risk Management Seminar, Florida Chamber of Commerce. Tampa, FL. November, 1995.

Air Contamination in Central and Eastern Europe: What We Have Seen Since the Iron Curtain was Pulled Back. For Carolinas Air Pollution Control Association. Myrtle Beach, SC. October, 1995.

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Protection. Tallahassee, Florida. September 27, 1995.

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MGP'95 International Symposium and Trade Fair on the Cleanup of Manufactured Gas Plants. Prague, Czech Republic. September, 1995. (*Session Moderator and Steering Committee Member*).

Seafood Poisoning: Biological & Nonbiological Effects of Contaminated Fish and Shellfish from the Gulf of Mexico. For U.S. EPA, Florida Department of Health & Rehabilitative Services. Tallahassee, FL; Corpus Christi, TX; Lafayette, LA; Biloxi, MI; Daytona Beach, FL and Orange Beach, AL. March 26, May 22, July 15, August 3, August 18, October 13, October 18, November 11, 1994, June 6, 1995.

Required Personnel Health and Safety Refresher Course for Hazardous Waste Activities (8 hours). For Levine•Fricke. Tallahassee, Florida. August 14, 1995.

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Protection. Tallahassee, Florida. May 18, 1995.

Worker Health and Safety Requirements. For U.S. Environmental Protection Agency RCRA Inspector Training Institute. Orlando, Florida. January 24-26, 1995.

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Protection. Ft. Myers, Florida. January 12, 1995.

RCRA Personnel Health and Safety Training Course (40 hours). For Florida Department of Environmental Protection. Orlando, Florida. December 5-9, 1994.

Training Course in Principles of Toxicology, Risk Assessment and Risk Communication. Conducted for Florida Department of Health and Rehabilitative Services. Jacksonville, Florida. November, 1994.

Risk Assessments: Understanding Their Strengths and Weaknesses (*Session Co-Chair*). For the Florida Bar Association, Environmental and Land Use Law Committee. Tampa, Florida. October 10, 1994.

Training Course for RCRA Inspectors. For Florida Department of Environmental Protection. Tallahassee, Florida. October 4-6, 1994.

Second International Symposium on Environmental Contamination in Central and Eastern Europe. Budapest, Hungary. September 20-23, 1994. (*Session Moderator and Steering Committee Member*).

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Protection. Tallahassee, Florida. August 23, 1994.

Regulations, Environmental Considerations and Safety Aspects of Petroleum Sites under Chapter 17-770. For Florida Department of Environmental Protection. Tallahassee, Florida. June 7-8, 1994.

Toxicology & Risk Assessment Training Course. Conducted for Florida Department of Environmental Protection. Tallahassee, Florida. May 18-19, 1994.

Seminars for Physicians and Medical Personnel on Public Health Implications of Toxic Materials and Hazardous Waste Sites. For Florida Department of Health and Rehabilitative Services and Agency for Toxic Substances and Disease Registry. Miami, Sarasota and Tallahassee, Florida. March 3, March 11, March 12, March 25 and March 30, 1994.

Required Personnel Health and Safety Refresher Course for Hazardous Waste Activities (8 hours). For Levine•Fricke. Tallahassee, Florida. March 7, 1994.

Training Course in Principles of Toxicology, Risk Assessment and Risk Communication. Conducted for Florida Department of Health & Rehabilitative Services. Jacksonville, Florida. February 3-4, 1994.

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Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. January 8, 1994.

RCRA Personnel Health and Safety Training Course (40 hours). For Florida Department of Environmental Regulation. Orlando, Florida. December 6-10, 1993.

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. July 8, 1993.

Personnel Health and Safety Refresher Course for RCRA Activities (8 hours). For Florida Department of Environmental Regulation. Orlando, Florida. May 20, 1993.

Medical Seminars on Public Health Implications of Hazardous Waste Sites. For Florida Department of Health and Rehabilitative Services and Agency for Toxic Substances and Disease Registry. Pensacola, Ft. Lauderdale and Miami, Florida. March, April, May, November, 1993.

Training Course in Principles of Toxicology, Risk Assessment and Risk Communication. Conducted for Florida Department of Health and Rehabilitative Services. Ft. Myers, Florida. January 28-29, 1993.

Personnel Health and Safety Refresher Course for Hazardous Waste Activities (8 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. December 9, 1992.

RCRA Personnel Health and Safety Training Course (40 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. November 16-20, 1992.

Required Personnel Health and Safety Refresher Course for Hazardous Waste Activities (8 hours). For Levine•Fricke. Tallahassee, Florida. November 18, 1992.

First International Symposium on Environmental Contamination in Central and Eastern Europe. Budapest, Hungary. October 21-24, 1992. (*Session Moderator and Steering Committee Member*).

Training Course in Principles of Toxicology and Risk Assessment. For Florida Department of Health and Rehabilitative Services. Orlando, Florida. July 23-24, 1992.

RCRA Personnel Health and Safety Required Refresher Course (8 hours). For Florida Department of Environmental Regulation. Orlando and Tallahassee, Florida. May 29, June 23 and September 15, 1992.

Training Course in Principles of Toxicology and Risk Assessment. Conducted for Florida Department of Health and Rehabilitative Services. Tallahassee, Florida. June 18-19, 1992.

General Principles of Toxicology and Risk Assessment (3 Graduate Semester Hours). For Department of Biological Science, Florida State University. Tallahassee, Florida. January to April, 1992.

Medical Seminar on Community Public Health Implications of Hazardous Waste Sites. For Florida Department of Health and Rehabilitative Services and Agency for Toxic Substances and Disease Registry. Rockledge, Miami, and Orlando, Florida. April 10, April 24, May 28 and October 22, 1992.

Personnel Health & Safety Refresher Course for Hazardous Waste Activities (8 hours). For Florida Department of Environmental Regulation. Orlando, Tallahassee, FL. April, October, November, 1991.

RCRA Personnel Health and Safety Training Course (40 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. January 4-8 and September 16-20, 1991.

Physician Training Course on Public Health Implications of Environmental Toxicants. For Florida DOH and ATSDR. St. Petersburg and Orlando, Florida. April, September, 1991.

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Supervisors Site Health and Safety Training Course for Hazardous Waste Activities (8 hours). For Levine•Fricke. Tallahassee, Florida. June 18, 1991.

Required Personnel Health and Safety Refresher Course for Hazardous Waste Activities (8 hours). For Levine•Fricke. Tallahassee, Florida. June 17, 1991.

Training Course on General Principles of Toxicology and Risk Assessment. Conducted for Florida Department of Health and Rehabilitative Services. Orlando, Florida. May 1-2 and May 21-22, 1991.

Training Course on Mixed Radioactive and Hazardous Waste. For Florida Department of Environmental Regulation. Tallahassee, Florida. October, 1990.

Physician Training Course on Public Health Implications of Environmental Toxicants. For Florida DOH and ATSDR. Tampa and Tallahassee, Florida. March 15 and July 24, 1990.

Mercury Contamination in Florida: Impacts and Solutions. Conducted by FSU Center for Biomedical & Toxicological Research, sponsored by 19 federal and state agencies. June 20-21, 1990.

Environmental Toxicology & Epidemiology: A Practical Approach for Local Health Officials and Physicians. For National Association of County Health Officials (NACHO), ATSDR, and Florida DOH. Ft. Lauderdale, FL. July, 1990.

RCRA Personnel Health and Safety Training Course (40 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. June 4-8, 1990.

RCRA Personnel Health and Safety Required Refresher Course (8 hours). For Florida Department of Environmental Regulation. Tallahassee, Florida. May 31, 1990.

RCRA Personnel Health and Safety: Basic Training Course (40 hours). For Florida Department of Environmental Regulation. Orlando, Florida and Tallahassee, FL. April 24-28 and December 4-8, 1989.

Groundwater Investigations and Application to Assessment of Risks. For Florida Department of Environmental Regulation. Tallahassee, Florida. June 6-7, 1989.

Risk Assessment & Decision-Making Training. Conducted for Florida Department of Environmental Regulation and U.S. Environmental Protection Agency. Tallahassee, Florida. August 30-31, 1988.

Training Course on General Principles of Toxicology & Risk Assessment. For Florida Department of Health & Rehabilitative Services. Tallahassee, Florida. September/October, 1987. Orlando, Florida.

Hazardous Materials Training (Risk Assessment; Hazardous Materials Contingency Plans). Conducted for National Hazardous Materials Training Center, Little Rock, Arkansas. October 28-30, 1986.

Training Course on Toxicology: Hazardous Waste Field Activities. Conducted for the Florida Department of Environmental Regulation and the Florida Department of Health and Rehabilitative Services. Tallahassee, Florida. June 25-26, 1986 and Orlando, Florida. October 8-9, 1986.

Training Course on Emergency Response and Contingency Planning. Conducted for the U.S. Environmental Protection Agency. Atlanta, Georgia. March, 1985; March, 1986.

Training Course for the Holmes Regional Medical Center: Employee Toxic Substances Right-to-Know Program. Conducted for the Holmes Regional Medical Center. Melbourne, Florida. 1986.

Attachment A

Training Seminar on the Florida Right-to-Know Law and Management of Hazardous Wastes by Hospitals. Conducted for the Florida Hospital Association (FHA). Orlando, Florida. August, 1986.

Training Seminar on the Florida Right-to-Know Law and Management of Hazardous Wastes by Hospitals. Conducted for the Florida Hospital Association (FHA). Orlando, Florida. November, 1985.

Hazardous Waste Disposal and Hazardous Substances Right-to-Know Regulations. Conducted for Florida Hospital Engineers Association. Orlando, Florida. April 4, 1986.

Second National Conference on Waste Exchange & Resource Reuse. Tallahassee, Florida. March, 1985.

Training Course on the OSHA Hazard Communication Standard. Orlando, Florida. February, 1985.

Symposium: Alternative Technologies for Waste Management. Tallahassee, FL. February, 1984.

Training Course on Toxicology and Risk Assessment. Conducted for the Florida Department of Health and Rehabilitative Services. Orlando, Florida. October 3-5, 1984.

Monitoring and Management of Hazardous Waste at RCRA Subtitle D Facilities. Conducted for U.S. EPA Office of Research & Development,. Tallahassee, Florida. October, 1984.

Symposium on EDB. Conducted for FL State University System. Tallahassee, FL. February, 1984.

Workshop on Monitoring Considerations in the Siting and Operation of Hazardous Waste Disposal Facilities in Temperate Zone Wet Environments. Conducted for the Office of Research and Development, U.S. Environmental Protection Agency. Tallahassee, Florida. October 4-5, 1983.

First National Conference on Waste Exchange and Resource Reuse. Tallahassee, Florida. March, 1983.

Training Course on Management of Hazardous Waste and Hazardous Materials. Conducted for the Florida Department of Environmental Regulation. Orlando, Florida. January 14-15, 1981.

Hazardous Materials Contingency Planning Workshop. Conducted for Region IV, Environmental Emergencies Branch, U.S. Environmental Protection Agency. Atlanta, Georgia. March 26, 1981.

Workshop on Hazardous Waste Management for Educational Institutions. Conducted for the Florida Department of Education. Orlando, Florida. February 3-4, 1981.

Hazardous Materials Incidents Workshop. For Leon County, Tallahassee, Florida. July, 1980.

State Waste Exchange Workshop. For Florida Chamber of Commerce. Tallahassee, FL. December, 1980.

Hazardous Waste Management Seminar. For Florida Engineering Society. Tampa, FL. Novem., 1980.

Attachment B

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